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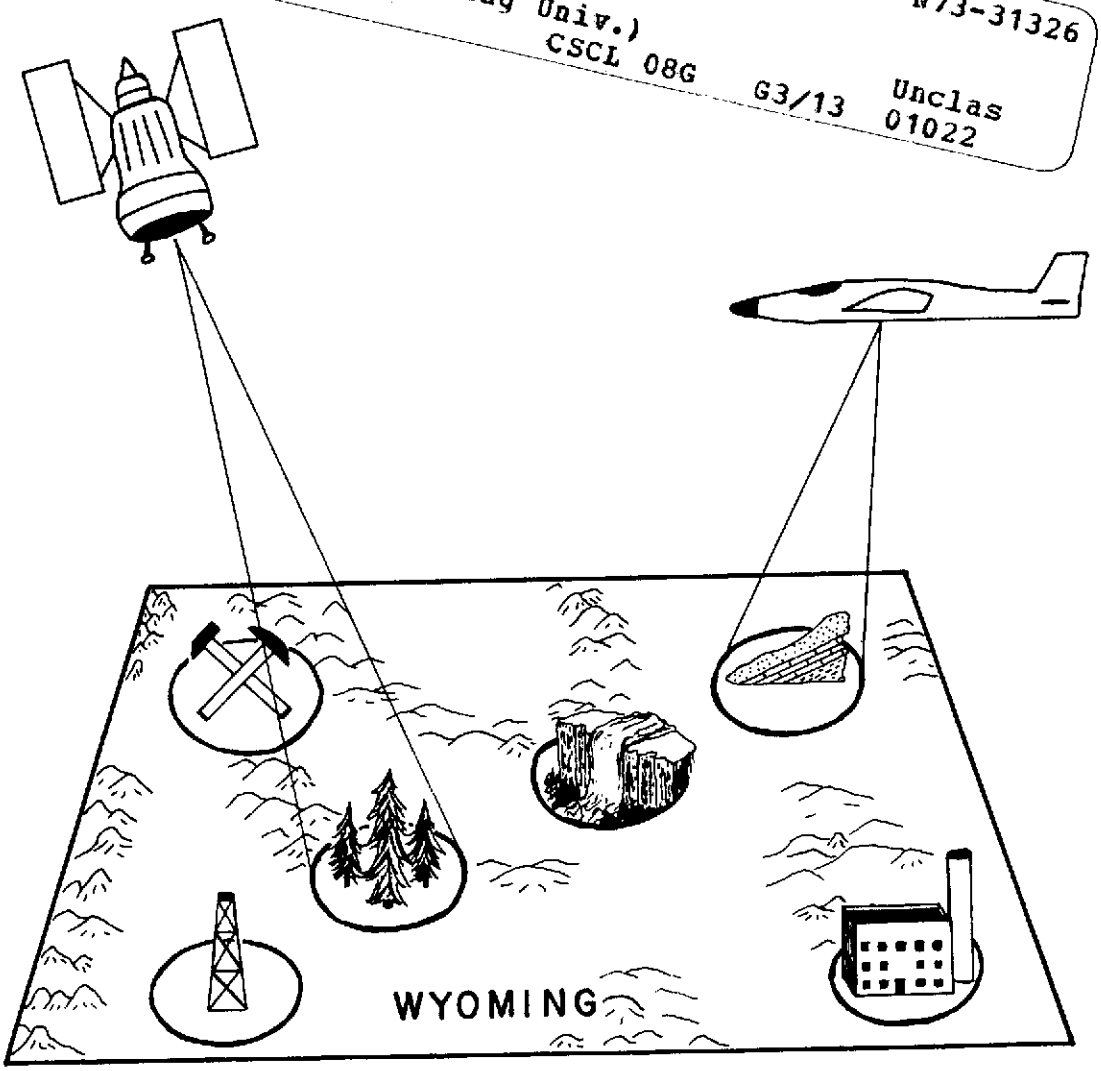

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16. Abstract

Of 16 studies currently in progress under NASA contract NAS 5-21799, five are nearing completion. Results of these five studies include: 1) successful use of ERTS-1 imagery for mapping meaningful vegetation contrasts in the Laramie Basin, 2) a structural mis-interpretation of the ERTS-1 imagery as a result of non-stereoscopic interpretation of an area where pseudo-structures are produced by topographic relief in regions of gently-dipping sedimentary units, 3) successful mapping of intrusive bodies and related dikes and fracture patterns in the Absaroka mountains, 4) a marginally successful attempt to map volcanic lithologies of the Yellowstone area, and 5) a map of the sand dune fields of Wyoming.

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Figure 2. Technical Report Standard Title Page

ANALYSIS OF ERTS-1 IMAGERY AND ITS APPLICATION TO EVALUATION OF WYOMING'S NATURAL RESOURCES

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Type I Report (July-August, 1973)

Prepared for

GODDARD SPACE FLIGHT CENTER
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CONTRACT OBJECTIVES

The principal objective of the Wyoming ERTS-1 investigation is to apply the satellite imagery and supporting aircraft and ground-gathered data to the study of geological, botanical, agricultural, hydrological, and cultural features. The resulting information aids in inventory, development, and management of natural resources.

WORK SUMMARY

All studies currently in progress under NASA contract NAS 5-21799 are summarized in Table 1. Of the 16 currently active studies, five are scheduled for completion in the next five weeks. Results of each of the five nearly completed studies are discussed briefly and summarized in the "Significant Results" section of this report, and will be presented in greater detail in forthcoming special reports prepared by the individual investigators.

The investigation into the application of ERTS-1 imagery in rangeland and forest vegetation mapping was originally begun by Mr. Francis Redfern of the University of Wyoming, Department of Botany. Mr. Redfern completed many of the image analyses before he left the University in summer, 1973, but none of the resulting maps had been fully evaluated at that time. Subsequently, Mr. Michael Evans, another graduate student in botany, has continued the Laramie Basin work with additional image analyses and field-checking. Mr. Evans is currently preparing a compilation report summarizing the entire study.

The Laramie Basin investigation demonstrated that brightness contrasts related to meaningful vegetation differences are recorded on the ERTS imagery. Techniques employed in the construction of the vegetation maps included band-compositing and isodensity contour mapping. An attempt was made to define the

TABLE 1. STUDIES IN PROGRESS

Study Name (investigator)	Current Status
Laramie Basin vegetation (Evans)	Report in final stages of preparation
Geologic map of the Hanna area (Barton)	Report in preparation
Volcanic rocks and intrusives of the Yellowstone/Absaroka region (Breckenridge)	Report in preparation
Wyoming sand dune fields (Kolm)	Report nearing completion - in final edit
Detailed geologic mapping in the Jelm Mountain area (Vargas)	Report in preparation
Estimation of above-ground green biomass (Gordon)	Image analysis and field work in progress
Grand Canyon geologic map (Sears/Houston)	Final image interpretation in progress
Study of clear-cut timber areas (Marrs/Houston)	Interpretive work begun
Biogeographic provinces of Wyoming (Evans)	Image studies in progress
Central Wyoming regional geology (Houston)	Interpretation and field-checks complete
Pseudo-color Wyoming photomosaic (Froman)	Special equipment built, photography one-fourth complete
Carbon County land-surface atlas (Marrs)	Interpretations in progress some field checks complete
Regional tectonics of the thrust belt (Vietti)	Initial interpretation in progress
Ratioing and cluster analyses (Decker/Borgman)	Researching clustering programs and data-display
Spectral reflectance catalogue (Marrs)	Data assembled, referencing and sampling being researched
Comparison of ERTS and EREP imagery (Tomes)	Comparisons in progress

maximum useful resolution of the ERTS system in this application by consideration of system resolution in combination with contrast, absolute brightness, and atmospheric scattering.

Mr. Ray Barton has recently completed a geologic interpretation of the ERTS imagery of the Hanna area. His completed map indicated a considerable number of folds and two closed structures which are not shown on the state geologic map, nor on any other published map. The field check of these structures revealed that the ground-pattern had been mis-interpreted. Many of the patterns interpreted as folds proved to be normal outcrop patterns produced by the combination of topographic highs and lows in the gently-dipping Tertiary sediments. The circular patterns interpreted as closed structures turned out to be large mudflats or playa basins. Stereoscopic re-examination of a portion of the area revealed the true nature of many of the pseudo-structures. The results of this study emphasize the desirability of obtaining and using stereoscopic imagery.

Mr. Roy Breckenridge has recently completed a geologic study of the intrusive and volcanic rocks of the Yellowstone-Absaroka region using ERTS imagery and high-altitude aircraft photography in his photogeologic interpretation. Field checking of the interpretation confirmed the existence of a complex fracture pattern which may control the distribution of intrusive bodies in the Kirwin area. The major components of this pattern were identified from the ERTS image. Smaller complementary structures that could not be detected on the ERTS imagery were mapped using the more detailed aircraft photography.

Mr. Breckenridge found that only a few of the pyroclastic lithologies could be adequately mapped from the imagery. Field studies indicated several contributing factors in this apparent lack of contrast: 1) dense vegetative cover (forest) over much of the area, 2) rugged topography with most good outcrops occurring on

steep slopes not imaged by vertical-looking sensors, 3) rapid lateral transitions between lithologic units that are mineralogically similar and simlar in their overall tone and color, 4) many of the volcanic lithologies are readily distinguishable only on the basis of their texture and fabric -- properties that cannot be observed from aircraft or satellite altitudes.

Mr. Ken Kolm has recently compiled a map of active and stabilized sand dunes of Wyoming. He has used the ERTS-1 imagery to locate and define the major sand dune areas and to segregate zones of active and passive dunes. In the course of his study, Mr. Kolm recognized a rather consistent re-vegetation pattern occurring through the stabilization cycle of Wyoming dunes. Identification of the vegetation community present in a sand-dune area may serve as a basis for remotely determining the migratory history of the dune field.

Mr. Rodrigo Vargas, a geology graduate student, is presently completing a detailed geologic map of the Jelm Mountain area of southern Wyoming. Mr. Vargas employed the 1:40,000-scale photography flown on NASA mission 213 in his work, and he compared the color, color infrared, and black-and-white photography of the area with regard to its overall utility for geologic mapping.

Mr. Vargas is not a regular member of the ERTS-1 investigative team at the University of Wyoming, but his study provides an excellent example of the additional benefit to be gained from the ERTS study and the aircraft data obtained in support of that study. Both the satellite imagery and the aircraft data will, undoubtedly, prove to be invaluable sources of geologic, hydrologic, botanical, and cultural data long after the current ERTS-1 investigations are complete. We anticipate that the permanent data base being established through the ERTS program will prove to be one of the most lasting benefits of the program.

SIGNIFICANT RESULTS

A summary of the significant results of the four studies completed during the July-August, 1973 period includes:

1. ERTS image brightness contrasts can be related to important contrasts in rangeland and forest vegetation communities of the Laramie Basin.

2. Stereoscopic viewing is essential for correct structural interpretation in outcrop patterns in some areas.

3. Complex fracture patterns which may have exerted a controlling influence on intrusive activity in the Absaroka Mountains can be mapped from ERTS.

4. Volcanic lithologies of the Yellowstone region are often differentiated on the basis of their textures, and cannot be successfully mapped by photogeologic interpretation of ERTS-1 imagery. Ground spectral readings confirm a general lack of contrast between these lithologies in the four ERTS MSS bands.

5. Major dune fields can be recognized and defined from ERTS image interpretations and recognition of differences in stabilizing plant communities (some of which may be mappable from ERTS) yields information about migration history of the dune fields.

DISCUSSION OF PROBLEMS

Several of the Wyoming studies (particularly those requiring repetitive or seasonal coverage) have been delayed by lack of appropriate data products. This problem was partially the result of failure to revise the standing data request to compensate for the delayed launch of ERTS-1. As a consequence, the imagery for several satellite passes during the autumn of 1972 was not received as part of the standing order and had to be ordered retrospectively. These orders were submitted in November and December, 1972, but, until recently, none of the retrospectively ordered data had been received.

We are pleased to report that this problem has been somewhat alleviated as we have recently received images for spring and summer, 1973 and some of the retrospectively ordered data.

ADEQUACY OF FUNDS

The delayed launch of ERTS-1 precipitated a delay in image analysis, field work, and formulation of a final data-analysis plan. Subsequently, the completion date for the Wyoming ERTS-1 studies was changed from December, 1973 to March, 1974 in order to allow sufficient time for the investigation to be completed. However, the program budget was not revised to accommodate the extension. Fortunately, our most recent budget update indicates sufficient surplus funds were accumulated during the period of delayed activity to cover the January-March, 1974 extension period. The budget will, however, require considerable revision and some transfer of funds between categories. We are presently preparing a revised budget which includes the necessary budget changes.

PLANNED WORK

Work scheduled for the September-October, 1973, period includes completion of reports on those five studies previously discussed and continued research on each of 11 other studies now in progress. Most of the work remaining on these studies can be done in the laboratory and can thus be completed during the winter months. Only a very limited amount of field work will be possible throughout the remainder of the contract period.

PERSONNEL

Two new people were added to the Wyoming investigative staff in August, 1973. Miss Barbara Tomes, a geology graduate student specializing in geomorphology, has begun working with the Wyoming team as a research assistant. Miss Tomes is currently making a detailed comparison of the ERTS-1 MSS imagery and the EREP S-190A photography.

A second new research assistant on the program is John Vietti. Mr. Vietti has been working with the structural geology of a portion of the Wyoming thrust belt and is now applying the ERTS imagery to a regional geologic study of the thrust belt.

In addition to the new research assistants, we currently have two work-study students who assist investigators in equipment operation and field work, and handle much of the routine data indexing and filing.